

NOVEL DECONTAMINATION WIPES

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ABSTRACT

The capability to decontaminate (preferably neutralize, but at least remove) chemical and biological agents in open-wounds of casualties is extremely valuable to the military. This capability will increase the safety and survivability of casualties and personnel in the course of medical treatment of casualties in an environment that is contaminated with chemical and/or biological threat agents, as well as allow medical personnel to more readily treat casualties in a safe and effective manner. The technology needs to be rapid but mild due to the sensitive nature of open-wounds. The effectiveness of a novel solvent saturated adsorbent pad as a wipe by removing a CWA simulant from pork skin and pork chops as surrogates for uncompromised and wounded human flesh was demonstrated. These results were substantiated by live animal tests performed at ICD. The pads have the ability to both absorb liquid and adsorb CB agents. The pads will be fabricated with a novel, non-shedding, adsorbent fiber material that will trap the CB agents, and not leave any residue on the decontaminated surface. The liquid in the pads is a demonstrated solvent for chemical warfare agents. This decontamination liquid is non-hazardous, nontoxic, nonflammable, and environmentally benign. Pads will be safe to use on personnel, will be compatible with a wide range of materiel, and inexpensive to use.

INTRODUCTION

Entropic Systems, Inc. (ESI) has teamed with the Performance Materials Division of 3M Company and Span Contract Packaging, Inc., an FDA registered packager of pharmaceutical and cosmetic products with cGMP compliant facilities, to offer a simple, safe, and effective **absorptive/adsorptive** decontamination wiping pad that consists of:

- a. a skin compatible liquid, 3M Novec™ HFE-7200 hydrofluoroether (ethoxyperfluorobutane), that dissolves the chemical agents one wishes to remove, and
- b. a multi-layer textile matrix that is capable of:
 1. retaining a significant amount of the solvent in its structure by absorption, and
 2. capture and bind the chemical agent dissolved in the decontamination liquid by adsorption.

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The upper layer of the matrix is a vapor barrier that retards evaporation of the decontamination liquid. The lower layer of the matrix is a mechanically strong permeable film that prevents shedding when the pad is drawn against the skin. This film is a component of wound dressing pads that are already in clinical use.

As shown in Figure 1, the dimensions of these wiping pads will be approximately 76 mm (width) x 152 mm (length) x 3 mm (thickness) [3" x 6" x 0.1"]. They will weigh approximately 30 g, and will be packaged in a sealed hermetically sealed 108 mm x 108 mm (4.25" x 4.25") pouch that is torn open when needed.

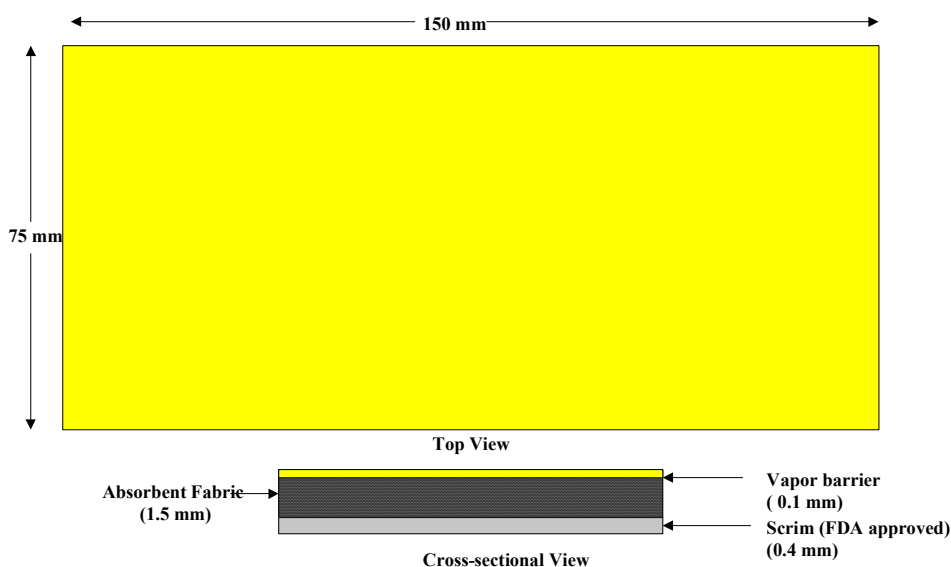


Figure 1 Structure of Proposed CWA Decontamination Wiper Pad.

The victim of contamination then wipes the affected area to remove the contaminant, which is transferred to the wipe. After use, the solvent evaporates, and the contaminant is retained and adsorbed in the wipe matrix. The used wipe can then be decontaminated by standard means, or placed in a disposable plastic pouch until it can be safely decontaminated or destroyed. An inherent advantage of this approach is its ease of use, and the fact that wiping requires little training.

RESULTS

This type of decontamination system offers a number of significant advantages over some of the other approaches being examined. These include:

EFFECTIVENESS

1. The decontamination activity of the pads is not chemistry specific. They will be effective against a broad range of toxic chemicals, including chemical warfare agents such as HD, GD, and VX. Nerve

agents such as GD and VX are miscible with HFE-7200, and HD exhibits sufficient solubility (about 4 wt-%) ¹.

2. Under the auspices of a Phase I SBIR program, it was demonstrated that HFE-7200 soaked activated carbon fiber wipes effectively remove (two to four log removal depending on the conditions) diethyl phthalate, a VX simulant, from pork skin and pork chops, used as simulants for human tissues ² (see Figure 2). In support of Block III JSSED, ECBC research activities, the Southern Research Institute has demonstrated that these wipes reduced the HD level on aluminum plates from 10 mg to below 100 ng, a decontamination factor > 10 ^{6 3}.
3. Some limited animal tests were performed at the U.S. Army Medical Institute for Chemical Defense (USAMICD). In these tests, guinea pigs were contaminated with increasing amounts of Soman (GD), and then decontaminated by a number of techniques, which included wiping with HFE-7200 saturated sponges and the application of the M291 decontamination powder. These results are presented in Figure 3, and can be summarized as follows:

Decontamination Method	Soman GD - LD ₅₀ , mg/kg	Protection Ratio
HFE-7200 Soaked Sponge	55	5.6
M 291 Decon Kit	17.7	1.8
No Post Application Decon	9.9	1

In these tests, the evaporation rate of HFE-7200 from the thin sponge slivers used as applicators was fairly high. It is believed that if the rate of evaporation of HFE-7200 had been lower, it would have been possible to attain higher LD₅₀ levels and higher protection ratios. The proposed laminated pads overcome this problem.

SAFETY

The proposed solvent, 3M's Novec HFE-7200 does not irritate or sensitize the skin, and has a low order of toxicity ⁴. A solvent soaked pad leaves no residue on the skin. The wiping layer that comes into contact with the skin is already in use in a FDA approved wound-dressing pad. The pads will be packaged in a way that they will not degrade with time, and can be expected to have a shelf life of many years. The proposed pads will be packaged in a FDA registered facility that is cGMP compliant. All these factors will greatly facilitate obtaining FDA approval for the use of these wipes on humans.

SCALING TO PRODUCTION

While currently experimental in nature, the proposed solvent-soaked wipes are made from materials that are currently commercially available. Supplying sufficient solvent and fabrics to support production quantities of both decontamination pads will not be an issue. The production capacity of a single commercial horizontal form, fill and seal pouch packaging machine is 400,000 pouches per week. Once in production, these pads are expected to be cost-competitive with the M 291kits now fielded by the military.

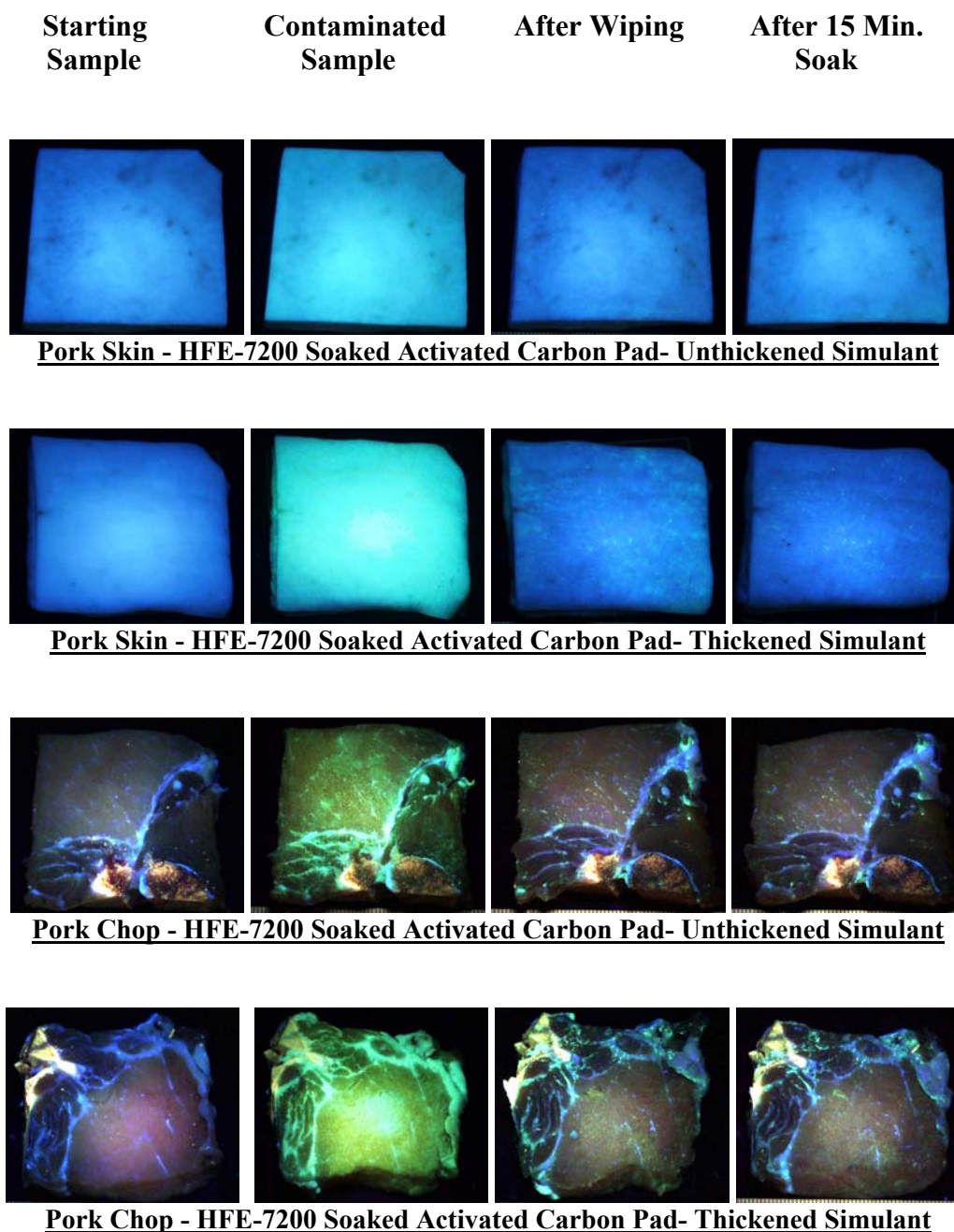


Figure 2. Removal of Fluorescent DEP Contaminant from Pork Skin and Pork Chop by Wiping with an Activated Carbon Composite Pad Initial Contamination Level: 1.6 g/m² to 3.2 g/m²(Photographs taken under UV Illumination)

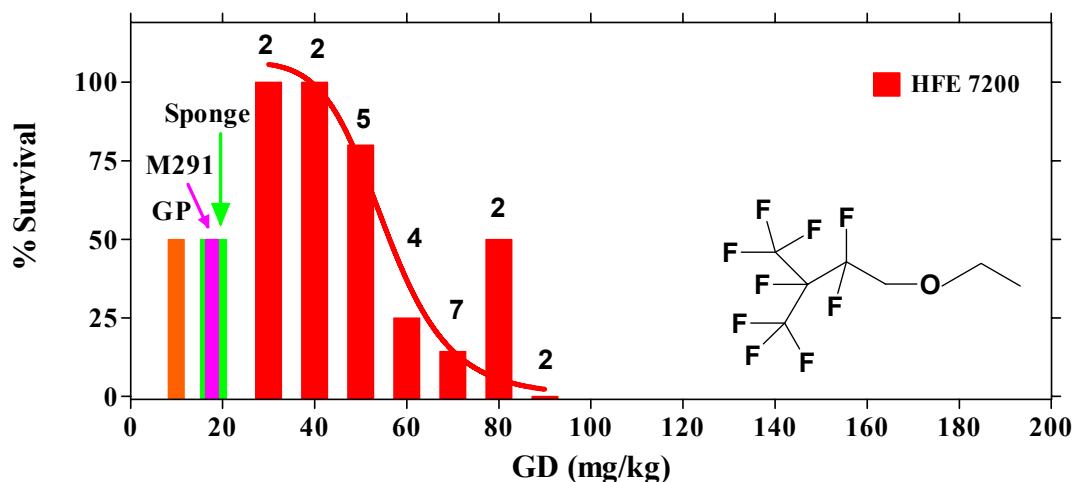


Figure 3. Decontamination Effectiveness of HFE-7200 Soaked Sponges.

CONCLUSIONS

Ethoxyperfluorobutane (HFE-7200) saturated absorptive-adsorptive wipes are a promising new method of effectively removing toxic chemical agents from skin.

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